CHEMICAL & ENGINEERING NEWS

C&EN

OCTOBER 19, 1992

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AMMONIA DIMER STRUCTURE CHALLENGES PHYSICAL CHEMISTS PAGE 20

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Difficulties abound in predicting supply and demand for scientists Page 24

CHEMICAL & ENGINEERING NEWS

C&EN

OCTOBER 19, 1992

NEWS OF THE WEEK

■ Chemist Rudy Marcus has won the Nobel Prize in Chemistry; biochemists Edmond Fischer and Edwin Krebs have been awarded the Nobel Prize in Physiology or Medicine. **Page 6**

■ The U.S. has reached an $11.6 million settlement with Chemical Waste Management in the largest claim ever obtained for environmental crimes prosecuted under Superfund. **Page 7**

■ Quantum Chemical has charged engineering firm M. W. Kellogg with fraud and negligence in the design and construction of Quantum's new ethylene cracker. **Page 7**

■ NASA proposes to shut down two satellites that carry instruments to monitor ozone depletion and global climate. **Page 8**

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Fast-track projects—those in which engineering and construction are carried out simultaneously—provide niche market for builders of chemical and refining plants. **Page 11**

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LETTERS

Basic science for the future

Today there is grave cause for concern about future support for truly basic research. For some years in the U.K. and to an increasingly worrisome degree in the U.S., there is a rising tide of opinion among science policymakers that scientific research should be entirely targeted to goals that will increase our prosperity and (to employ the reigning buzzwords) our international competitiveness. Overzealous and ill-considered pursuit of these intrinsically worthy goals can seriously damage our capacity to achieve those very goals.

Let it be clearly acknowledged at the outset that the reason scientists, technologists, and engineers are supported from the public treasury is because the public expects to benefit from their work. There is nothing wrong with that implicit contract. It is a meritorious example of enlightened selfishness on the part of the citizenry, few of whom are themselves scientists or engineers, but all of whom enjoy the fruits of the labors of scientists and engineers in the form of safer, more comfortable, healthier, more fulfilling, longer lives.

The question is not whether, but how public support of research can be used more effectively. What are the essential components of a strategy that can meet all of our needs—both short term and long term?

First, it is easy to understand that in a modern industrial society many technical problems exist, and that it is appropriate to dispense research grants and contracts to those scientists and engineers who are proven (by peer review, preferably) to have the competence to deal with these technical problems and who desire to do so. For engineers, this is essentially the whole picture, because engineering is by definition the application of scientific knowledge to the practical needs of society. Engineers exist to achieve designated practical ends, and, therefore, that part of our research support system that funds people who work toward predefined goals serves the needs of engineers admirably. It also admirably serves the interests of the citizenry who pay for it.

Many scientists also find themselves very well accommodated by a research support system that deals with predefined problems requiring scientific study. These people are the applied scientists. For the most part they are employed in industry or in the laboratories of task-oriented government agencies. The fact that these scientists do applied research does not preclude the possibility that their work may turn up some new fundamental facts or concepts that have purely intellectual as opposed to (or in addition to) practical validity. But that is not their purpose, and if they are funded to solve practical problems their success should be measured by how well they do so. There are also applied scientists and engineers in universities and it is entirely appropriate—indeed absolutely necessary—that this be so.

However, there is another group of scientists whose place in universities (and in our overall scientific effort) is also both appropriate and necessary. These are the scientists who do what some call basic research or pure research. I dislike both of these terms because they are overloaded with ambiguity and snobbishness. I would prefer the term curiosity-driven research. In other words, there is research undertaken solely to answer questions concerning the still-unexplored aspects of the world around us without any predetermined use or application for the results that will be obtained.

Curiosity-driven research is an indispensable part of a complete national research strategy and is as fully deserving of support from the citizenry as research in engineering and applied science. Why? Because the applied science of the future will simply wind down in ever-decreasing circles to sterility without new and unanticipated increments to fundamental knowledge. Applied research cannot for long simply feed on itself; new facts and new concepts are what underlie real progress as opposed to a chain of ever-smaller incremental improvements.

Let us consider some examples. I'll choose only three; there are many more.

- We will begin with the use of x-rays to determine the structure of matter. Most of the practical successes in materials science today, as well as our understanding of genetics and enzymes would never have happened if physicists such as Max von Laue had not studied the interactions of x-rays with matter—just because they were curious.
- The studies by Lord Rutherford, and others, of the fundamental nature of atomic nuclei ultimately led to the use of

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New Graduates Face Tight Job Market

DEMAND

October marks the beginning of the recruiting season for companies hoping to hire next spring's crop of new chemistry and chemical engineering graduates. And, although there's always some uncertainty this early in the season, the year that's just beginning isn't shaping up to be a good one to be entering the job market with a new degree in these fields.

The general economic recession that made last year perhaps the worst in a decade to be entering the job market lingers on. Some employers of chemical professionals—such as makers of consumer products and pharmaceuticals—are fairly resistant to economic downturn, and at some of these firms demand for new professional staff remains high. But chemical and petroleum companies, whose demand for newly graduated chemists and chemical engineers makes the difference between a good year to be job hunting and a bad one, are very sensitive to conditions in the overall economy. With no clear economic turnaround in sight, many of these firms will be very cautious in their hiring in 1993.

C&EN tracks the volume of "positions open" advertising carried on its pages. It's an indicator of changes in demand for chemical professionals that has accurately reflected demand in recent years. The most recent "high" was an extended one that lasted through much of 1987 and 1988. Advertisements for positions to be filled started falling off about the end of 1988 and drifted downward, though far from steadily, well into 1991. Since then, the graph's been bumping along, up for a month or two and then down again, sending out signals that it might be ready to turn around, but never quite doing so.

That jagged line pretty much sums up the employment picture for this year's graduates. Much like the overall economy, chemical professional employment seems to be stuck in a recession that it can't quite get out of.

Certainly last year was not a good year to be looking for a first job in chemistry or chemical engineering. It wasn't a good year for midcareer chemical professionals, either, as major chemical and petroleum companies cut their expenses by, among other measures, reducing the size of their professional staffs.

For some companies, and on some campuses, the employment outlook for 1993 appears to be somewhat better. But even that modest claim isn't likely to be a universal one. Other schools and other companies predict that the coming year will be a repeat of last year or, perhaps, even worse.

Cautious, deliberate recruiting characterizes this year's efforts on the part of many chemical companies, suggests James D. Burke, manager of research recruiting and university relations at Rohm & Haas. "Companies will worry more about overhiring than underhiring," Burke says, at a time when the economy seems to be moving somewhat awkwardly toward recovery. "Now that we've all had a pretty good year, we're more willing to go out and invest in our future" by hiring professional staff, he says. He's predicting that recruitment efforts may start out slowly in the first half of the year but pick up in May or June if company profits do likewise.

At Du Pont, the outlook for 1993 recruitment is a little better than last year. For a year and a half, Du Pont has been in the midst of a program to cut its operating costs that has included reducing the size of its work force. Although that program will continue into next year, most of the staff reductions have already occurred, and its biggest impact on recruiting took place last year.

During the 1992 recruiting year, which ended last month, Du Pont hired about 175 chemists and chemical engineers at all degree levels, estimates Richard T. Koffenberger, a senior college relations supervisor. That's down substantially from hiring levels of two or three years ago. In fact, the company did not recruit on campuses at all last fall, although it did make some campus visits during the winter. Essentially all the hiring that occurred was of people who had prior experience with Du Pont through co-op programs, for example, or summer internships.

This year Koffenberger estimates Du Pont's hiring will be up by perhaps a third. That's partly because the cost reduction programs have been effective in improving the company's profitability and partly because some sectors of its business have held up fairly strongly. But another important reason, he says, is that "we recognize the value and need to continually bring in new professional staff who understand the workplace of today." In this regard, he says, "we have considerable pent-up demand for people." That demand will be tempered by an obligation to current employees, who are being considered first to fill available positions whenever their skills match those needed.

As is generally the case, Du Pont's principal needs will be for chemical engineers and Ph.D. physical scientists. "We have an increasing need for analytical chemists, at both the doctoral level and other levels," Koffenberger says. He expects demand will be up for polymer chemists, too.

Again this year, prior experience

with Du Pont will be a big plus in getting an offer of a full-time job. Du Pont will be recruiting on campuses this fall, but at a smaller number of schools than the company used to visit. It also will be recruiting through the employment clearinghouses of professional organizations, such as the American Chemical Society. Faculty contacts on many campuses, who bring promising students to the company's attention, and résumés mailed in by job seekers will also provide avenues for landing a job.

Supply of Ph.D. chemists alone is rising

Academic year	Degrees awarded in chemistry			Degrees awarded in chemical engineering		
	Bachelor's	Master's	Ph.D.	Bachelor's	Master's	Ph.D.
1979–80	11,446	1733	1551	6383	1271	284
1980–81	11,347	1654	1622	6527	1267	300
1981–82	11,062	1751	1722	6740	1285	311
1982–83	10,746	1604	1746	7145	1304	319
1983–84	10,704	1667	1744	7475	1514	330
1984–85	10,482	1719	1789	7146	1544	418
1985–86	10,116	1754	1908	5877	1361	446
1986–87	9,661	1738	1976	4983	1184	497
1987–88	9,052	1708	1995	3917	1088	579
1988–89	8,654	1785	2034	3684	1097	599
1989–90	8,126	1696	2183	3450	1030	564

Source: National Center for Education Statistics

Monsanto, too, will be on campus recruiting this year, though it's looking for only about half the number of inexperienced chemists and chemical engineers it used to hire in a "typical" year. That puts hiring of new graduates at around 50, just about the same level as last year, says Robert J. Mason, corporate director of university relations. That level is enough to replace professional staff who leave because of retirement and other factors and to provide for slight staff growth. In addition, Monsanto will be doing "quite a bit of hiring in the experienced ranks," Mason says. The reason: More employees than anticipated took advantage of the company's early retirement incentives offered last year.

Dow, on the other hand, will be hiring many fewer chemical professionals this year than last, according to James E. Townsend, manager of university relations for Dow Chemical USA. Townsend expects the company will hire about 40 chemists and chemical engineers this year, half of them probably Ph.D.s. That's about half the number Dow hired last year and one fourth the number it has been used to hiring. As a result, campus recruiting will be very limited. Almost all bachelor's- and master's-level hiring will be of people who've already worked for Dow as part of a co-op or internship program. Part of the reason college hiring will be so low, Townsend says, is that, unlike Du Pont and Monsanto, Dow has not cut its midcareer professional staff.

The companies in the best position to hire new chemists and chemical engineers this year are those outside the chemical and petroleum industries, says Ted J. Logan, manager of technical recruiting at Procter & Gamble. In addition to his own company, Logan cites other consumer products companies and drug firms as good places to look for a job. "Our products are in demand even in a recession," he points out. Procter & Gamble has a high demand for engineers and Ph.D. scientists this year and did so last year as well, Logan says. Though the outlook for new chemistry Ph.D.s in general is gloomy this year, demand is considerably stronger for Ph.D.s with degrees in analytical or synthetic organic chemistry, he says, because of demand from outside the oil and chemical industries.

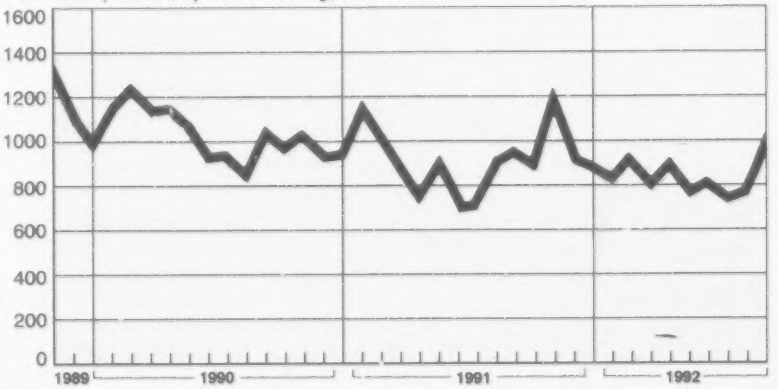
Ph.D. chemists would be wise to look beyond the chemical and petroleum industries for the best job opportunities this year, agrees Rebecca J. Simon, placement director for the school of chemical sciences at the University of Illinois. Given the downsizing that's been taking place at many chemical and petroleum companies as well as general economic conditions, Ph.D. candidates last year didn't have as many choices as they are used to. This year, she says, employers seem to have their fingers crossed, hoping to hire a few more chemists and chemical engineers than they did last year. But that pickup likely will be more at the bachelor's and master's level than for Ph.D.s, she suggests.

Merck will be hiring chemical and other scientific professionals at about the same level as last year, says Anthony D. Rizello, manager of college relations. Although profits are strong, the company is being cautious about short-term staffing and only hiring to fill vacancies caused by attrition. Merck is looking to hire about 100 scientists this year, with an emphasis on chemists, and about 150 engineers in all areas, Rizello says. That's only about 40% of the number of new graduates Merck was hiring each year in the late 1980s. "We're primarily trying to maintain a certain size professional staff," Rizzello says.

At Phillips Petroleum, the view is much gloomier. "These are the toughest times that I have ever seen for students looking for a job," says E. L. Baughn, director of employment and college relations. Petroleum companies in general,

Help-wanted ads in C&EN up from 1991 low

Volume of "positions open" advertising, column-inches[a]



a Column-inches published during consecutive periods of four weeks each; no issues were published in the last week of 1989, 1990, and 1991.

and Phillips in particular, have cut their recruiting plans 80 to 90% over the past couple of years, he says. Phillips, which used to hire 200 to 300 new college graduates each year, is looking for "something like 20 or 30" this year. Last year, it hired 35; the year before, more than 200.

Unlike recruiters at many chemical companies, Baughn predicts that oil company recruitment may never return to the levels of the past. Although demand for new graduates will pick up, he expects it to stabilize for his company at about half of earlier levels. That same pattern holds for most petroleum companies, he says. "The unfriendly drilling environment in the U.S. today is driving jobs overseas in our industry even faster than is happening in the automobile industry," Baughn says. And as drilling moves abroad, so, too, will technical jobs.

This past year saw Phillips reduce its overall staff by 1500 people as part of a broad-ranging program to cut operating costs. This was but the most recent of several staff reductions and cost-cutting moves at Phillips in the past decade, Baughn points out. The company has been the target of repeated take-over attempts, all defeated, but at a cost in areas such as professional staffing.

Phillips isn't doing any campus recruiting this year, although the recruiting staff will be going to career fairs on college campuses this fall "to tell students that jobs are very minimal," Baughn says. He's hoping that "after the first of the year, we'll have some jobs."

Petroleum companies have traditionally been a major employer of chemical engineers. And engineering placement offices on college campuses confirm Baughn's assessment that recruiting by these firms is down sharply this year. "Petroleum companies haven't so much canceled their recruiting as cut way back on their schedules," says Sandra Arnn, director of engineering career services at the University of Wisconsin, Madison. Demand for chemical engineers continues strong at other types of employers, however, such as paper, pharmaceutical, and food processing companies. Chemical companies, too, still seem to be looking hard for chemical engineering graduates, she says.

Chemical and petroleum engineers have been the engineers in highest demand for the past several years. This year, at Wisconsin, that demand has shifted only slightly, so that chemical and environmental engineers now seem the most sought after. Last year, 42% of

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employers contacting her office were looking for chemical engineers, Arnn says. That preference is certainly holding this year, as well, she adds. "It seems as though the demand [for chemical engineering graduates] is going to continue," she says. Although the search may be somewhat more difficult than in past years, she's expecting all graduates in this field at Wisconsin will find jobs.

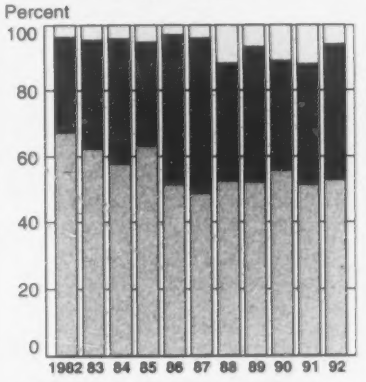
What happens to graduates when they can't find jobs? Judging by last year's example, most stay in school. ACS's starting salary survey, conducted last summer, found 49% of newly graduated bachelor's-level chemists intending to be in graduate school this fall, up from 42% the year before and from 36% in 1990. The picture was almost the same for chemistry Ph.D.s—43% of last year's graduates had accepted postdoctoral positions for this year, compared with 37% in 1991 and 34% in 1990.

Of course, postdoctoral experience is a usual step in the career progression of scientists preparing for research careers in academia, and some companies—Monsanto, for example—prefer to hire postdocs to fill their Ph.D. positions. But the recent, rapid buildup of Ph.D.s accepting postdoctoral appointments is beginning to cause some concern.

"In many fields—physics, mathematics, and computer sciences—there seem to be more people coming out with Ph.D.s than jobs available," says Alan Fechter, executive director of the National Research Council's office of scientific and engineering personnel. "In many cases these people wind up in postdocs as a temporary holding pattern. There's a big group of people out there in postdocs waiting for the market to open up. My fear is that they might be considered damaged goods. They might be at a disadvantage compared to someone just out of school."

And some Ph.D. candidates simply take longer to complete their degree. At the University of Wisconsin, Madison, for example, 45 Ph.D. candidates in chemistry signed up to interview with industrial employers last year. Of that group, nine found positions in industry; two took academic positions; and eight accepted postdoctoral positions, although only half really wanted the positions—the other half would have preferred a job in industry if they had found one, says Audrey L. Aylesworth, placement coordinator for the chemistry department. Of the remainder, 20 are back again this year, still working on a Ph.D., and still looking for industrial employment. There are always a few Ph.D. candidates signing up to see recruiters more than a year before they actually receive their degrees, Aylesworth says, but the number of returnees this year is unprecedented.

Ph.D. chemists stay in school in tight job market



Note: Data as of the summer of each year.
Source: ACS annual surveys

At the same time, formal unemployment—that is, the number of people who say they are actively looking for work and unable to find it—actually declined for new chemistry graduates last year at both the bachelor's and Ph.D. levels, according to the ACS survey. At the B.S. level, it dropped to 10.4% from 14.0% in 1991; for Ph.D.s, the decline was even more dramatic, going from 11.5% in 1991 to 4.5% this past summer.

When will the recruitment picture change? "If and when the economy changes," says Procter & Gamble's Logan, echoing the sentiment of most observers. And that's unlikely to be for at least a year, he adds. Dow's Townsend is predicting a pickup in hiring in 1994 and a return to "normal" levels for Dow by 1995. Mason expects Monsanto will have doubled its present entry-level hiring in five years, bringing hiring back to its pre-recession levels. But whether that pickup will begin next year or somewhat later depends on the economy. □

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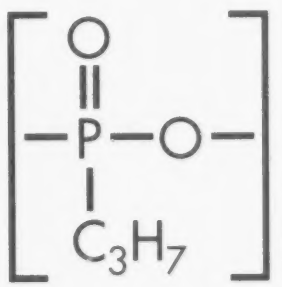

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